CLAIMS

1. A method of diagnosing corrosion risk of a pipe or a pipeline buried in soil due to DC stray currents and/or AC voltages induced in the soil, comprising:

i) providing a two-part metal probe including a first probe part having a first metal element of a first size and a first specific resistivity, said first probe part constituting an exposed element, and a second probe part having a second metal element of a second size and a second specific resistivity, said second probe part being hermetically sealed and constituting a reference element,

ii) burying said two-part metal probe in said soil,

iii) measuring the AC current flowing between said pipe or said pipeline and said two-part metal probe,

iv) measuring the AC voltage between said pipe or said pipeline and said two-part metal probe,

v) measuring the spread resistance based on said AC current determined in step iii) and said AC voltage measured in step iv) according to Ohm's Law,

vi) passing a first excitation current through said first probe part and determining the voltage generated by said first excitation current across said first probe part for measuring the resistance of said first probe part according to Ohm's Law,

vii) passing a second excitation current through said second probe part and determining the voltage generated by said second excitation current across said second probe part for measuring the resistance of said second probe part according to Ohm's Law,

viii) storing said measurements provided in steps iii), iv), v), vi) and vii),

ix) repeating said steps iii), iv), v), vi), vii) and viii) periodically,

x) determining the corrosion of said first probe part based on the measurements performed in steps vi) and vii) according to a mathematical corrosion algorithm, and

xi) diagnosing the risk of corrosion of said pipe or pipeline based on an empirical combination of the actual corrosion of said first probe part, said spread resistance determined in step v) and said AC voltage measured in step iv).

2. The method according to claim 1, said first probe part and said second probe part having identical metal elements.

3. The method according to claims 1 or 2, said step x being performed in accordance with the following equation:

$$\sigma(t) = \sigma(t=0) \cdot \frac{R_R(t)}{R_C(t)} \cdot \frac{R_C(t=0)}{R_R(t=0)}$$

4. The method according to any of the claims 1-3, said diagnosing of step xi) being performed in accordance with the following table:

Event	Active corrosion	Spread resistance	AC voltage	Diagnose
1	no	high (1-10Ωm²)	low (below approx. 10V)	No risk
2	no	high (1-10Ωm²)	high (above approx. 10V)	No critical condition but monitor spread resistance further
3	no	low (0.001-0.1Ωm²)	low (below approx. 10V)	No critical condition but be aware of increased AC voltage
4	no	low (0.001-0.1Ωm²)	high (above approx. 10V)	Risk of AC corrosion incubation period
5	yes	low (0.001-0.1Ωm²)	high (above approx. 10V)	AC corrosion – take mitigation actions
6	yes	low (0.001-0.1Ωm²)	low (below approx. 10V)	Corrosion may arise from DC stray current

7	yes	high (1-10Ωm²)	low (below approx. 10V)	Corrosion may arise from DC stray current
8	yes	high (1-10Ωm²)	high (above approx. 10V)	Corrosion may arise from DC stray current

5. The method according to claim 4, said spread resistance being high provided the value of said spread resistance being above 0.1-1 Ohm and being low provided the value of said spread resistance being below 0.1-1 Ohm.

6. The method according to any of the claims 4 or 5, said AC voltage being high provided said voltage being higher than approximately 10V.

7. The method according to any of the claims 1-6, said steps 3, 4, 5, 6 and 7 being repeated with a frequency of one or more days.

8. A system of diagnosing corrosion risk of a pipe or a pipeline buried in soil due to DC stray currents and/or AC voltages induced in the soil, comprising:

i) a two-part metal probe including a first probe part having a first metal element of a first size and a first specific resistivity, said first probe part constituting an exposed element, and a second probe part having a second metal element of a second size and a second specific resistivity, said second probe part being hermetically sealed and constituting a reference element, and having a cable for connection to an external measuring apparatus,

ii) a measuring apparatus including :

a housing,

a cable connector for the connection of said cable of said two-part

metal probe to said external measuring apparatus included within said housing,

an AC current measuring circuit for measuring the AC current flowing between a pipe or pipeline and the two-part metal probe when said probe is buried in said soil,

an AC voltage measuring circuit for measuring the AC voltage between said pipe or said pipeline and said two-part metal probe when said two-part metal probe is buried within said soil,

a resistance measuring circuit connected to said AC current measuring circuit and said AC voltage measuring circuit for determining the spread resistance based on Ohm's Law,

a current excitation circuit for passing through said cable a first excitation current to said first probe part and for measuring the voltage generated by said first excitation current across said first probe part for measuring the resistance of said first probe part according to Ohm's Law and for passing a second excitation current through said cable to said second probe part and for determining the voltage generated by said second excitation current across said second probe part for measuring the resistance of said second probe part according to Ohm's Law,

storage means for storing the measurements made by said AC current measuring circuit, said AC voltage measuring circuit, said spread resistance measuring circuit and said current excitation circuit, and

a diagnosing circuit for diagnosing the risk of corrosion of said pipe or pipeline based on an empirical combination of the actual corrosion of said first probe part, said spread resistance and said AC voltage.

9. The system according to claim 8, wherein said measuring apparatus including a micro processor constituting part of said AC current measuring circuit, said AC voltage measuring circuit said spread resistance measuring circuit, said current excitation circuit, said storing circuit and said diagnosing circuit and controlling the overall operation of the apparatus for periodically repeating the measurements.

10. The system according to any of the claims 8 or 9, wherein said measuring apparatus includes two or more cable connectors for establishing connections to two or more two-part metal probes.

11. The system according to any of the claims 8-10, wherein said measuring apparatus further includes a data connector for connecting to an external

device, said external device receiving information regarding said two-part metal probe or in the alternative said two or more two-part metal probes.

12. The system according to any of the claims 8-11 further adapted for the performance of the method according to any of the claims 2-7.

13. A two-part metal probe for use in carrying out the method according to any of the claims 1-7 and for use in the system according to any of the claims 8-12 and including a first probe part having a first metal element of a first size and a first specific resistivity, said first probe part constituting an exposed element, and a second probe part having a second metal element of a second size and a second specific resistivity, said second probe part being hermetically sealed and constituting a reference element.

14. A measuring apparatus for use in carrying out the method according to any of the claims 1-7 and constituting a part of the system according to any of the claims 8-12.